Integrated Presentation to Social Networks and the Implementation of Innovations in Schools

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Yong Zhao

Kenneth Frank’s work was supported by grants from the Social Capital Interest Group at Michigan State University and a Spencer/National Academy of Education Fellowship. Data were collected partly through a grant awarded by the Michigan Department of Education under the Technology Literacy Challenge Fund grant program. Travel to some sights was supported by the National Science Foundation (9874246).

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Implementation of Innovations in Schools: General Themes

Innovations and Reforms are Rarely Fully Implemented
  Bryk and Schneider; Tyack; Cuban; Ravitch
  Examples: Constructivist Teaching, Systemic Reform, Technology

Schools as Social Organizations and Implementation as a Social Process
  Cognitive or psychological research to scale up implementation doesn’t work
  Must attend to diffusion within the school, conveyed by the social structure of the school

The Social System of the School
  Indirect diffusion
  Competing innovations and demands
  Larger context of district, state, and institutions

Interplay of Implementation of Innovation and Social Structure

  Social structure conveys implementation
    Fragmented social structure 6uneven implementation 6further fragmentation
    Catholic schools avoid fragmentation by resisting innovations?
    Implementation can alter social relations, modify social structure

Professional Development
  Supported Experimentation

Theories
  Diffusion of innovations
  Social capital as extension of social exchange
  Ecosystems
Guiding Pragmatic Questions

Does social capital matter for the implementation of innovations?

What aspects of professional development matter?

If social capital matters, who helps whom use computers?

How does an innovation diffuse throughout a school?

Do we have a systemic conceptualization of implementation and diffusion?
General Descriptions of our Studies

Ken’s Spencer data (2000-2001)
6 schools (4 pure elementary, 1 elementary + middle school, 1 high school)
Urban, suburban. Racially mixed
Surveys & Interviews
Longitudinal measures of technology use, identification with collective

Social Network (who helps whom, who talks to whom about technology, who is colleagues with whom)

Response rates better than 70% in 5 schools

same as above, but:
25 schools, mostly suburban and rural
originally cross-sectional, now longitudinal
includes new focus on professional development
90% response rate or better in most schools
Overview of Current Papers


Frank, K.A. “A Theory and Empirical Test of Identification with a Collective as a Quasi-Tie”. To be submitted soon, based on several presentations.


Social Capital and Implementation (Influence)

Q: Does social capital matter? Definition: potential to access resources through social relations
The Influence Predictor

Influence of Expertise of Others on Computer Use

Access to expertise through help = interaction × resource:

\[ Access \text{ to expertise through } help_i = \sum_{\substack{i' \neq i \atop i'=1}}^{n-1} (help_{i'i}) \times (\text{provider's expertise}_i) \]  

Can also account for ability to convey resource:

\[ = \sum_{\substack{i' \neq i \atop i'=1}}^{n-1} (help_{i'i}) \times (\text{provider's expertise}_i) \times (\text{amount of help provided to others}_i) \]
## Measures for Social Capital and Implementation

### Teacher’s Use of Technology at Time 2 (\(r = .94\))

**I use computers to help me...**

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Yearly</th>
<th>Monthly</th>
<th>Weekly</th>
<th>Daily</th>
</tr>
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<tr>
<td>1</td>
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<td>4</td>
<td>5</td>
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</tr>
</tbody>
</table>

- Introduce new material into the curriculum.
- Guide student communication.
- Model an idea or activity.
- Connect the curriculum to real world tasks.
- Teach the required curriculum.
- Motivate students.

<table>
<thead>
<tr>
<th></th>
<th>indicates mean response.</th>
</tr>
</thead>
</table>

### Expertise (\(r = .76\)):

- Use at time 1 for teacher and student purposes (e.g., to help students communicate)
- Total number of applications with which the teacher was familiar at time 2
- Extent to which the teacher reported being able to operate computers at time 2
- How confident the teacher felt with computers at time 2

### Social pressure (\(r = .66\)):

- Others in this school expect me to use computers;
- Others in this school encourage me to use computers;
- Knowing about computers increases opportunities for collaboration at XX;
- Using computers helps a teacher become integrated into XX.
### Factors Related to Computer Implementation

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Corr, partial for school</th>
<th>Corr, partial for school and own expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occurrences of computer use (teacher report)</strong></td>
<td>196</td>
<td>251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log of occurrences of computer use</td>
<td>4.26</td>
<td>1.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Social Capital</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to expertise through help and talk</td>
<td>-1.43</td>
<td>1.67</td>
<td>.28</td>
<td>.26</td>
</tr>
<tr>
<td>Perceived social pressure to use computers</td>
<td>2.96</td>
<td>.49</td>
<td>.36</td>
<td>.28</td>
</tr>
<tr>
<td><strong>Perceived Potential</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived potential of computers for teacher use</td>
<td>3.25</td>
<td>.51</td>
<td>.34</td>
<td>.26</td>
</tr>
<tr>
<td>Perceived potential of computers for student use</td>
<td>3.30</td>
<td>.51</td>
<td>.19</td>
<td>.08</td>
</tr>
<tr>
<td><strong>Technology Resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of time teacher had significant technical problems using computers</td>
<td>1.54</td>
<td>.80</td>
<td>.00</td>
<td>.07</td>
</tr>
<tr>
<td>Perceived adequacy of physical resources</td>
<td>1.82</td>
<td>.65</td>
<td>.14</td>
<td>.22</td>
</tr>
<tr>
<td>Perceived adequacy of organizational support</td>
<td>2.59</td>
<td>.68</td>
<td>.16</td>
<td>.07</td>
</tr>
<tr>
<td><strong>Job Conditions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class size</td>
<td>21.66</td>
<td>6.44</td>
<td>-.25</td>
<td>-.21</td>
</tr>
<tr>
<td>Grade (data available for only 60 teachers)</td>
<td>4.71</td>
<td>2.55</td>
<td>.00</td>
<td>-.06</td>
</tr>
<tr>
<td>Teaching multiple grades</td>
<td>.54</td>
<td>.50</td>
<td>.10</td>
<td>.10</td>
</tr>
<tr>
<td>Years in School</td>
<td>7.35</td>
<td>6.46</td>
<td>.03</td>
<td>.07</td>
</tr>
<tr>
<td><strong>Job Stress</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workload</td>
<td>3.13</td>
<td>.58</td>
<td>-.10</td>
<td>-.07</td>
</tr>
<tr>
<td>Teaching a new grade</td>
<td>.16</td>
<td>.37</td>
<td>.02</td>
<td>.10</td>
</tr>
<tr>
<td>Teaching a new subject</td>
<td>.11</td>
<td>.32</td>
<td>.04</td>
<td>.10</td>
</tr>
<tr>
<td>Perceived changes in emphasis on standardized tests</td>
<td>3.86</td>
<td>.86</td>
<td>-.15</td>
<td>-.06</td>
</tr>
</tbody>
</table>
# Model of Log of Occurrences of Computers Use at Time 2

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>OLS Coefficient (Standard Error)</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to expertise through help and talk</td>
<td>.23** (.09)</td>
<td>.21</td>
</tr>
<tr>
<td>(social capital)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived social pressure to use computers</td>
<td>.56* (.28)</td>
<td>.16</td>
</tr>
<tr>
<td>(social capital)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived potential of computers for teacher use</td>
<td>1.02* (.44)</td>
<td>.18</td>
</tr>
<tr>
<td>(perceived potential – traditional diffusion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived adequacy of physical resources</td>
<td>.90** (.33)</td>
<td>.19</td>
</tr>
<tr>
<td>(technology resources – traditional diffusion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class size</td>
<td>-.04* (.02)</td>
<td>-.12</td>
</tr>
<tr>
<td>(job conditions)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived changes in emphasis on standardized tests</td>
<td>-.34* (.17)</td>
<td>-.16</td>
</tr>
<tr>
<td>(job stress)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own Expertise</td>
<td>.71*** (.17)</td>
<td>.32</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.24 (1.32)</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td>adjusted R²</td>
<td>.38</td>
<td></td>
</tr>
</tbody>
</table>

*p ≤ .05; **p ≤ .01; ***p ≤ .001.

n=143

Q: Does social capital matter?
A: As much as classic predictors of implementation such as resources and perceptions
  (Frank, K. A., Zhao, Y., and Borman, K 2004)
Implications

I. Schools may improve implementation as much by focusing on social structure as on changing attitudes or improving resources.

   Leveraging social capital is cheap and quick relative to changing attitudes or purchasing resources

II. Attempts to implement multiple innovations may compete for fixed social capital

   Failure to fulfill multiple obligations may be detrimental to overall social capital

III. Success of implementation depends on distribution of social capital

   Are there sources of expertise available to each actor?

   Existing rifts can impede implementation and be exacerbated by varied implementation

IV. Complementary flows of social pressure and help

   Derive from, and contribute to, membership in common organization (Durkheim)

   Help from those with greater expertise to those with lesser expertise

   Conformity from those with lesser expertise to those with greater expertise
### Professional Development

**Q: What aspects of professional development matter?**

**Application of Computers to Student Learning at Time 2: Includes Professional Development**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>OLS Coefficient (Standard Error)</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional development focuses on student learning</td>
<td>44.04*** (12.52)</td>
<td></td>
</tr>
<tr>
<td>Access to expertise through help and talk</td>
<td>42.14* (16.50)</td>
<td></td>
</tr>
<tr>
<td>Opportunities to experiment with district supported software</td>
<td>14.58a (8.91)</td>
<td></td>
</tr>
<tr>
<td>Professional development occurs in the classroom</td>
<td>33.92*** (9.52)</td>
<td></td>
</tr>
<tr>
<td>Professional development occurs in a school lab</td>
<td>2.38 (6.05)</td>
<td></td>
</tr>
<tr>
<td>Professional development conducted by outside experts (negative interaction with prior use)</td>
<td>-15.52* (7.79)</td>
<td></td>
</tr>
<tr>
<td>Prior Use</td>
<td>84.23*** (12.76)</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>OLS Coefficient</th>
<th>Standardized Coefficient</th>
</tr>
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<tbody>
<tr>
<td>R²</td>
<td>.47</td>
<td></td>
</tr>
<tr>
<td>adjusted R²</td>
<td>.34</td>
<td></td>
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</tbody>
</table>

* a p ≤ .10; * p ≤ .05; ** p ≤ .01; *** p ≤ .001. n=364.

**A: focused on student learning, allow for supported experimentation in natural setting (outside experts good for novices)**

Who Helps Whom Use Computers? (Selection)

Extant Theories

- Colleagues (social exchange)
- Colleagues of colleagues (generalized exchange)
- Members of dense subgroups (cross-cutting exchange and norms due to closure)

Quasi-Ties

Perceived social relationship that directs the allocation of resources

*Example* Identification with the collective

*Motivation* Anticipated shared interests

Because actors anticipate sharing the interests of others as members of a collective, they allocate resources to others in the collective

*Implication* Overriding of direct social relationships – actors who identify with the collective will allocate equally to any member of the collective, regardless of specific social relationships
Figure 3
Reasons for Allocating resources

a) Social Exchange via Direct Social Relationships (Blau)

b) Generalized Exchange via Chain of Social Relationships (Emerson and Ekeh)

c) Cross-Cutting Exchange via Closure (Coleman)

d) Systemic Exchange via Quasi-Ties (proposed)

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Resource Allocation

Direct Social Relationship

Identification with the Collective
Cross Nested Multilevel Poisson Regression (i.e., $p_2$ social network model)

**Figure 4**
Modeling the Allocation of Resources from $i \to i$ via $p_2$-like approach

Characteristics of Pair
(social tie, status differences, etc.)

Characteristics of Provider

Characteristics of Receiver

Quasi Tie

Allocation of Resource $A$

Allocation of Resource $B$

(Conveyed by a Social Tie)

New Opportunities

Interest and Control of $A$

Interest and Control of $B$
<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Coefficient</th>
<th>Cross-Level Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential provider listed potential receiver as a close colleague</td>
<td>.191**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.037)</td>
<td></td>
</tr>
<tr>
<td>Identification with the collective of potential provider × close colleague</td>
<td>-.153*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.078)</td>
<td></td>
</tr>
<tr>
<td>Identification with the collective of potential receiver × close colleague</td>
<td>-.306**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.094)</td>
<td></td>
</tr>
<tr>
<td># close colleagues common to potential provider and receiver</td>
<td>.095**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.009)</td>
<td></td>
</tr>
<tr>
<td>Identification with the collective of potential provider (i’) × # close colleagues common</td>
<td>-.131**</td>
<td>.016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of close colleagues of potential provider- # of close colleagues of potential receiver (difference in status)</td>
<td>-.086</td>
<td>(.127)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expertise of potential provider - expertise of potential receiver</td>
<td>2.144**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.491)</td>
<td></td>
</tr>
<tr>
<td>Potential reciprocity: help from potential receiver to potential provider</td>
<td>.013**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.002)</td>
<td></td>
</tr>
<tr>
<td>Potential provider and receiver are members of same subgroup</td>
<td>1.161**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.065)</td>
<td></td>
</tr>
<tr>
<td>Potential provider and receiver teach in same grade</td>
<td>1.248**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.070)</td>
<td></td>
</tr>
<tr>
<td>p*: degree centrality (increase in variance of uᵢ and vᵢ)</td>
<td>-25.532**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.032)</td>
<td></td>
</tr>
<tr>
<td>Potential Continuity: previous help from potential provider to receiver</td>
<td>.0006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0005)</td>
<td></td>
</tr>
</tbody>
</table>

School effects estimated with dummy variables not reported. Data analyzed for 101 school actors, 2844 pairs (only pairs within schools). *magnitude of coefficient > 1.96 approx standard error; **magnitude of coefficient > approx standard error.
Q: Who Helps Whom Use Computers?
A: Close colleagues, colleagues of colleagues, and someone who identifies with the collective of the school (Frank, to be submitted)

Implications

Quasi-Ties can facilitate flow of resources
- Resources go where needed most
- Contributes to even diffusion of innovation
- Social systems less likely to fragment
- Not reliant on intense social relations for social capital

How to build quasi-ties?
- Common rituals
- Shared decision-making
- Allow social capital to be manifest

Measurement: use actors as respondents, not informants
- E.g. “I belong in this school” vs “This school is one big happy family”
- Allows for variation within social system – some people fit better than others
- Can look for internal causes and consequences
- More reliable measurement
Q: How Does Innovation Diffuse Throughout a School?

Each number is a teacher. G = grade, teacher teaches. Lines connecting two numbers indicate teachers who are close colleagues. Solid lines within subgroups, dashed between. Circles indicate cohesive subgroups. How does innovation diffuse throughout a school?
Crystalized Sociograms with Subgroups Integrate Organization Theories

Openness of schools to external institutions:
    Some teachers respond more directly to external changes and institutions than others.

Loose Coupling:
    Not all teachers respond directly to the administrative change.
    Not all teachers respond directly to each other.

Multilevels:
    Teachers make sense of change through their subgroup members.
    Subgroup members have the most direct influence on each other.

School Decision-making:
    Not by edict or policy, but through slow change of teachers’ behaviors as influenced by each other.
Additional Findings and Implications

Findings from quantitative models including 19 schools

Talk about curriculum is concentrated within grades and subgroups at comparable levels, although technology talk more likely to transcend grades.

*New* Talk about technology tends to occur *between* subgroups.

Talk about technology *anticipates* new collegial ties.

Implications

Talk guided by enduring social structure (grades, subgroups, close colleagues)

True for traditional (curriculum) and innovation (technology)

Suggests most coordination structured by same components, although different specific conversations

Innovation may change social structure

Q: How does an innovation diffuse throughout a school?

A: Talk about technology occurs within grade, and subgroup and between close colleagues and teachers of similar perceptions.

Roughly within and then between subgroups (Frank, K. A. and Zhao, Y. 2004)

*Ecosystem as Metaphor (Zhao and Frank AERJ 2003)*

Q: Do we have a systemic conceptualization of implementation and diffusion
Implications
Why an Ecological Perspective on Innovation Implementation?

Systemic dynamics
The implementation process changes the context

History matters
An implementation context often reflects a history of attempted implementations

Within group interactions matter
Individuals of a species compete and cooperate in the presence of invading species
Individuals of a species may determine the species survival

Between group interactions matter
Species exhibit different behaviors in response to other species, which affects how they interact

Connects individual psychological factors to sociological factors
Cost-benefit analysis is mostly psychological but is in response to, and will affect, the social relationships
Social relationships affect the perceptions of individuals, which affects their cost-benefit analysis and subsequent behaviors
Questions and Our Answers

Q: Does social capital matter for the implementation of innovations?
A: As much as classic predictors of implementation (Frank, K. A., Zhao, Y., and Borman, K 2004).

Q: What aspects of professional development matter?
A: focused on student learning, allow for supported experimentation in natural setting (outside experts good for novices)

Q: If social capital matters, who helps whom use computers?
A: Close colleagues, colleagues of colleagues, and someone who identifies with the collective of the school (Frank, to be submitted)

Q: How does an innovation diffuse throughout a school?
A: Within and then between subgroups (Frank, K. A. and Zhao, Y. 2004)

Q: Do we have a systemic conceptualization of implementation and diffusion
A: Ecosystems (Zhao and Frank 2003)?

In the Works

Ken and Yong (we have sociograms for 25 schools ordered by mean increase in implementation, controlling for other salient school level factors):
**What social structures facilitate implementation at the school level?**

Ken and Yong: collect multiple time points (5) of social network data and measures of implementation of curricular reform among teachers in schools in China


Ken with SRI (3 years, longitudinal, 40 schools)

*Analyze effects of social structure on implementation for technology versus other reforms*

*Can sociograms be used to help implement reforms?*

Ken with Gary Sykes (2 years, cross-sectional, 20 schools)

*How do board certified teachers integrate into schools and share knowledge with others?*

Yong with Bill Schmidt: Virtual Professional Development Network for PROMISE
Participants React:

How does distributed leadership relate to social capital?

How do teachers' access to expertise affect their implementation of innovations?

Why do teachers help each other implement innovations? Do they discriminate to whom they provide help?

What resources flow in other systems?

Generally, why would one actor allocate resources to another?

How do multiple innovations interact/compete to draw on social capital?

How do reforms change social structures?

Return to your answers for the Scramble
Future Hopes

How does implementation process change social structure?

   Can it change longstanding close collegial ties, or more casual relationships?
   What types of implementations change Ties?

Broaden types of innovations
   different reforms, pedagogical approaches, governance

Broaden types of schools
   More urban, variation in districts, regions

Apply to organizations other than schools
   DNR, fishermen, hospitals, virtual communities (quasi-ties?)

Broaden collaboration:
   People from business, fisheries and wildlife, access to other schools
Confidentiality/Ethical issues in Collecting Network Data

Need names on survey

Data can be confidential but not anonymous (especially for longitudinal)


Who benefits from network analysis? Who bears the cost?


Issues to raise when dealing with Human Subjects Board:

Klovdahl, Alden S. Social network research and human subjects protection: Towards more effective infectious disease control Pages 119-137

Hint on Human Subjects boards: they like precedents. Once you have one network study accepted, refer to it when submitting others!
Logistics of Data Collection

Need for longitudinal data to disentangle selection from influence  
(Matsueda and Anderson 1998; Leenders 1995).

Time constraints: how long does a network question take?  
Without roster: 2-3 minutes  
With roster: 5-10 minutes (depending on size of network)

High response rates (70% or more) needed to characterize system, influence  
incentives: school, individual  
administer in collective settings (e.g., staff meeting)  
do not be perceived to be affiliated with principal

Network data without survey?  
Sensors  
Participation in events (two-mode)  
on-line e-mails  
web links

Organizing data entry
check out: http://www.classroomsociometrics.com/

Your name Lisa Jones (person 1)

Please list your closest colleagues (*network 1*) at xxx and the frequency with which you interact with each person.

<table>
<thead>
<tr>
<th>Name</th>
<th>Yearly</th>
<th>Monthly</th>
<th>Weekly</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bob Jones</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</tr>
<tr>
<td>2. Sue Meyer</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3. ----------------</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</tr>
<tr>
<td>4. ----------------</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Data entered (chooser, chosen, frequency)
1 2 2
1 3 4

Your name Bob Jones (person 2)

Please list your closest colleagues (*network 1*) at Hueco and the frequency with which you interact with each person.

<table>
<thead>
<tr>
<th>Name</th>
<th>Yearly</th>
<th>Monthly</th>
<th>Weekly</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lisa Jones</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2. Lin Freeman</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3. ----------------</td>
<td>2</td>
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<td>4</td>
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</tr>
<tr>
<td>4. ----------------</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Data entered (chooser, chosen, frequency)
2 1 2
2 4 4
Physicists and Social Networks


Mark Newman and Duncan Watts
http://www.santafe.edu/~mark/

M. E. J. Newman, A. L. Barabasi, and D. J. Watts (Eds.).
The Structure and Dynamics of Complex Networks

Duncan J. Watts.
http://smallworld.columbia.edu/watts.html
Six Degrees: The Science of a Connected Age.

The Dynamics of Networks Between Order and Randomness

Economists and social networks

**Institute for Social Network**
**Analysis of the Economy (ISNAE: is-nay)**
http://www.isnae.org/
http://www.fas.at/business/en/

Kenneth Arrow: http://cesp.stanford.edu/mediaguide/kennethjarrow/

http://www-personal.umich.edu/~axe/

Stephen Durlauf:
http://www.ssc.wisc.edu/econ/Durlauf/
Introductory Materials and other Web Resources

Good introductory materials


Borgatti’s slide show: http://www.analytictech.com/networks/intro/index.html

David Knoke’s intro to social network methods: http://www.soc.umn.edu/%7Eknoke/pages/SOC8412.htm


Jim Moody’s course: http://www.sociology.ohio-state.edu/jwm/
Other Web Resources

**International social network analysis web page:** [http://www.insna.org/](http://www.insna.org/)

**Agna portal:** [http://www.geocities.com/imbenta/agna/links.htm](http://www.geocities.com/imbenta/agna/links.htm)

**Individual Web Pages:**

Phil Bonacich [http://www.sscnet.ucla.edu/soc/faculty/bonacich/home.htm](http://www.sscnet.ucla.edu/soc/faculty/bonacich/home.htm)

Ron Breiger ([http://www.u.arizona.edu/~breiger/](http://www.u.arizona.edu/~breiger/)):

Ronald Burt (google Ron Burt):
[http://portal.chicagogsb.edu/portal//server.pt/gateway/PTARGS_0_2_332_207_0_43/http%3B/portal.chicagogsb.edu/Facultycourse/Portlet/FacultyDetail.aspx?&min_year=20044&max_year=20063&person_id=30400](http://portal.chicagogsb.edu/portal//server.pt/gateway/PTARGS_0_2_332_207_0_43/http%3B/portal.chicagogsb.edu/Facultycourse/Portlet/FacultyDetail.aspx?&min_year=20044&max_year=20063&person_id=30400)

Ken Frank [http://www.msu.edu/~kenfrank/](http://www.msu.edu/~kenfrank/)


James Moody [http://www.sociology.ohio-state.edu/jwm/](http://www.sociology.ohio-state.edu/jwm/)

Tom Snijders [http://stat.gamma.rug.nl/snijders/](http://stat.gamma.rug.nl/snijders/)

Barry Wellman: [http://www.chass.utoronto.ca/~wellman/](http://www.chass.utoronto.ca/~wellman/)